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Section A

For each question, there are four possible answers **A, B, C,** and **D**. Choose the **one** you consider to be correct.

1 When 10.0 cm^3 of a 0.10 mol dm^{-3} solution of alkali metal salt **MX**O_3 was reduced with an excess of acidified potassium iodide solution, the resulting iodine required 60.0 cm^3 of 0.10 mol dm^{-3} sodium thiosulfate solution for its reduction. The anion could be reduced to

A **X**O_2

B **X**O^{2-}

C **X**O^{-}

D **X**$^{-}$

Option **D**:
$(5-n)\ e + X^{5+} \rightarrow X^{n+}$ ---(1)
$2I^- \rightarrow I_2 + 2e$ ---(2)
$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$ ---(3)
No of mol of $S_2O_3^{2-}$ = 60.0/1000 x 0.10 = 0.006
$\therefore$ No of mol of I_2 = ½ x 0.006 = 0.003
$\Rightarrow$ no of mol of I^- = 0.003 x 2 = 0.006
No of mol of X^{5+} = 10/1000 x 0.10 = 0.001
$\therefore$ 6I- = X^{5+}
(2) x 3,
$6I^- \rightarrow 3I_2 + 6e$
$\Rightarrow$ 5-n = 6
$\therefore$ n = -1

2 10 cm^3 of a hydrocarbon is mixed with 100 cm^3 of oxygen gas which is in excess. The mixture is exploded and after it is cooled to room temperature, the residual gases occupy a volume of 80 cm^3. Upon passing the gases through potassium hydroxide, this volume decreases to 50 cm^3. What is the formula of the unknown hydrocarbon?

A C_3H_6

B C_3H_8

C C_4H_8

D C_4H_{10}

Option **B**:
$C_xH_y + (x+y/4)\ O_2 \rightarrow xCO_2 + y/2\ H_2O$
Volume of CO_2 = 30 cm^3
By using Avogadro's Law,
Mole ratio $\equiv$ volume ratio
$\therefore$ no. of mol of CO_2 = 3
$\Rightarrow$ x = 3
Volume of O_2 remaining = 50 cm^3
$\therefore$ volume of O2 reacted = 100 – 50 = 50 cm^3
$\Rightarrow$ x+(y/4) = 50/10
5 = x+(y/4)
$\therefore$ y = 8
Hence, formula of the hydrocarbon is C_3H_8.

3 *The use of Data Booklet is relevant to this question.*

The successive ionisation energies, in kJ mol^{-1}, of an element **X** are given below.

870 1800 3000 3600 5800 7000 13200

What is element **X**?

A $_{33}As$

B $_{53}I$

C $_{8}O$

D $_{52}Te$

Option **D**:
The greatest jump is between the 6th and 7th I.E. Hence element **X** must be in group VI. Therefore, either O or Te is the answer. But with reference to the Data Booklet, the I.E. values do not correspond to that of oxygen. Hence, element **X** is Te.

4 A 10.0 dm^3 sample of oxygen at a pressure of 250 kPa and 3.0 dm^3 sample of nitrogen at a pressure of 500 kPa are introduced into a 2.5 dm^3 vessel at room temperature. What is the total pressure in the vessel?

A 750 kPa

B 1200 kPa

C 1600 kPa

D 1950 kPa

Option **C**:
Using Boyle's Law,
$P_1V_1 = P_2V_2$
$P_{O2}\ V_{O2} = P_{O2}'\ V_{vessel}$
$250(10.0) = P_{O2}'\ (2.5)$
$P_{O2}' = 1000$ kPa
$P_{N2}\ V_{N2} = P_{N2}'\ V_{vessel}$
$500(3.0) = P_{O2}'\ (2.5)$
$P_{N2}' = 600$ kPa
$\therefore P_T = P_{O2}' + P_{N2}'$
$= 1000 + 600$
$= 1600$ kPa

5 Given that the standard enthalpy change of combustion of but-1-ene and ethene are ***p*** and ***q*** kJ mol^{-1} respectively. What is the standard enthalpy change of the reaction: $2C_2H_4(g) \rightarrow C_4H_8(g)$?

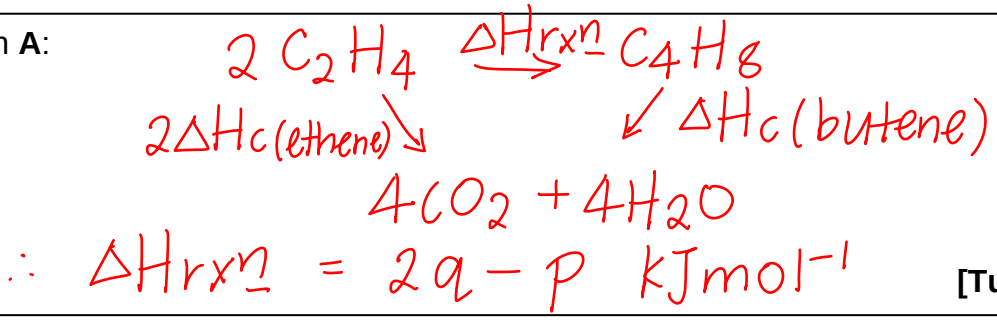
A $2q - p$ kJ mol^{-1}

B $(p + q)/2$ kJ mol^{-1}

C $q - 2p$ kJ mol^{-1}

D $(q - p)/2$ kJ mol^{-1}

Option **A**:



6 The data below refers to the standard molar enthalpy changes of combustion of some members of the alkanes.

Alkane	ΔH_c^{θ}/kJ mol^{-1}
CH_4	–890
C_2H_6	–1560
C_3H_8	–2220
C_4H_{10}	–2880
C_5H_{12}	–3510
C_6H_{14}	–4190

Another alkane **X** has a standard enthalpy change of combustion of –6780 kJ mol^{-1}. The formula of **X** is likely to be

A C_9H_{20}

B $C_{10}H_{22}$

C $C_{11}H_{24}$

D $C_{12}H_{26}$

Option **B**:
The difference in ΔH_c accounts for every $-CH_2$ chain which is approximately 670 kJ mol^{-1}. Therefore, by observing the trend, the formula of **X** is $C_{10}H_{22}$.

7 The data below refers to the radii and charges of six ions.

Ion	P^{2+}	Q^{+}	R^{+}	T^{2-}	U^{-}	V^{-}
Radius/nm	0.16	0.19	0.15	0.16	0.19	0.15

PT, **QU** and **RV** are ionic solids of the same lattice structure. Which one of the following gives the correct order of their lattice energies with the lowest numerical value first?

A **PT** **RV** **QU**

B **PT** **QU** **RV**

C **RV** **QU** **PT**

D **QU** **RV** **PT**

Option **D**:
This question requires students to apply the knowledge of the lattice energy expression involving charge and ionic radius. Hence, **QU** should have the lowest numerical value with the largest radii (sum) and lowest charge (product). **PT** should have the largest numerical value with the smallest radii (sum) and largest charge (product).

8 In the presence of ultraviolet light, the "inert" xenon gas will react with fluorine gas to produce XeF_4 according to the equation,

$$Xe\ (g) + 2\ F_2\ (g) \rightleftharpoons XeF_4\ (s)$$

What is the correct equilibrium constant K_c?

A $\dfrac{[Xe][F_2]}{[XeF_4]}$

B $\dfrac{[XeF_4]}{[Xe][F_2]}$

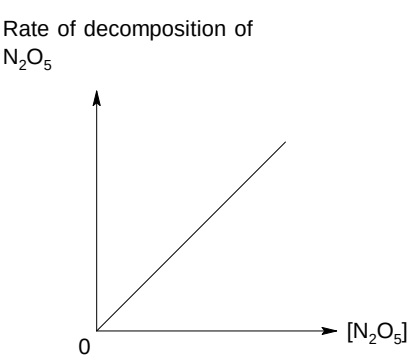
C $\dfrac{[XeF_4]}{[Xe][F_2]^2}$

D $\dfrac{1}{[Xe][F_2]^2}$

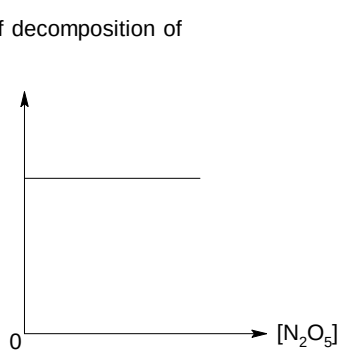
Option **D**:
In writing the K_c expression involving solid reactants or products, they do not have a concentration term. Hence, they are just given a numerical value of 1.

9 The decomposition of dinitrogen pentoxide N_2O_5 is found to be first order with respect to the concentration of N_2O_5. Which one of the following graphs confirms the results?

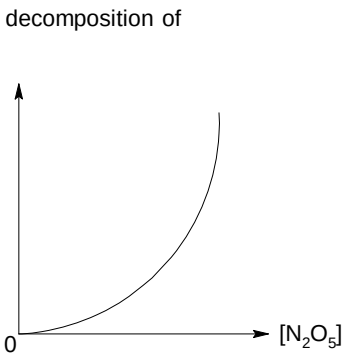
A



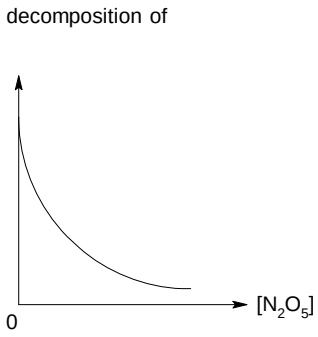
B



C



D



Option **A**:
Since the decomposition of N_2O_5 is 1st order w.r.t. $[N_2O_5]$,
$\Rightarrow$ rate α $[N_2O_5]$
$\therefore$ rate = $k[N_2O_5]$
$\Rightarrow$ straight line graph passing through the origin.

10 What is the pH of the final solution formed by mixing equal volumes of two separate portions of dilute sulfuric acid of pH 2.0 and pH 4.0?

A 2.3

B 2.6

C 3.0

D 3.6

Option **A**:
pH = 2.0 $\Rightarrow$ $[H^+] = 10^{-2}$
pH = 4.0 $\Rightarrow$ $[H^+] = 10^{-4}$
$[H^+]_{total} = (10^{-2} + 10^{-4})/2 = 5.05 \times 10^{-3}$
Resultant pH = -lg 5.05×10^{-3} = 2.3

11 Hydrogen iodide is not prepared by the addition of concentrated sulfuric acid to solid sodium iodide. This can be best explained by the fact that

A Hydrogen iodide is not displaced by sulfuric acid.

B Iodide ions are oxidised to iodine.

C Sodium sulfide is formed as an impurity.

D Hydrogen iodide is less volatile than concentrated sulfuric acid.

Ease of oxidation of halide increases down the group.
$NaI + H_2SO_4 \rightarrow HI + NaHSO_4$
$8HI + H_2SO_4 \rightarrow 4I_2 + H_2S + 4H_2O$

12 Which one of the following gives the correct definition of an acid according to the Bronsted-Lowry theory?

A It dissociates in water to give $H^+(aq)$ ions.

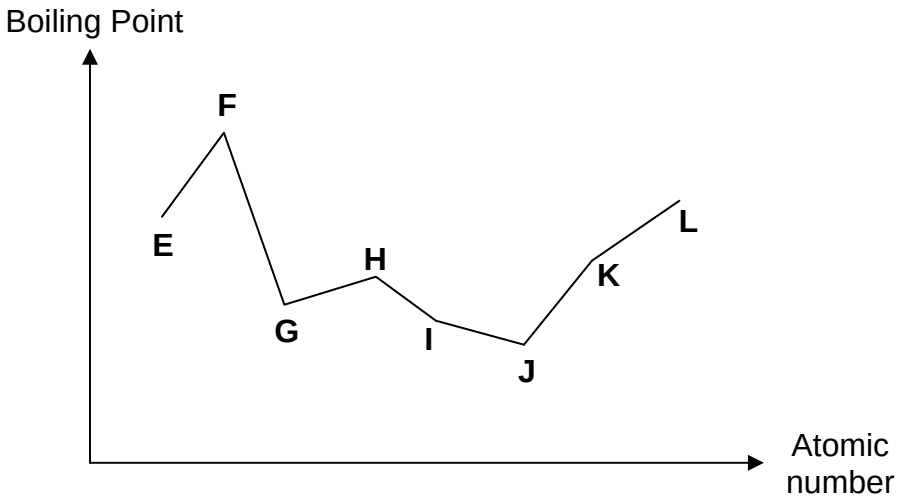
B It is a proton donor.

C It is a proton acceptor.

D It is an electron donor.

A It dissociates in water to give $H^+(aq)$ ions → Arrhenius definition of acid
B It is a proton donor → Bronsted – Lowry definition of acid
C It is a proton acceptor → Bronsted – Lowry definition of base.
D It is an electron donor → reducing agent

13 The graph below shows the variation in the boiling points for eight consecutive elements in the Period Table, all with atomic numbers from 10 to 20. The letters do not represent any element in the Periodic Table.



Which of the following can be deduced from the graph above?

A Element **H** forms an acidic oxide only.

B Element **K** does not conduct electricity.

C Element **G** can exist in two allotropic forms.

D Element **E** and beryllium are in the same group.

Look for elements with proton numbers 10 to 20 in the Periodic Table. Identify the element **F**, which has the highest melting point as silicon, hence **F** is Group IV. Given that the elements are in consecutive order, **H** is a Group VI element, which only forms acidic oxides.

14 A typical chemical reaction is acid catalysed, and the reaction is first order with respect to the hydrogen ion. If all other conditions are kept constant, what is the ratio of $\frac{\text{rate of reaction at pH 3}}{\text{rate of reaction at pH 1}}$?

A 0.01

B 0.33

C 1

D 3

$$\frac{\text{Rate of reaction at pH 3}}{\text{Rate of reaction at pH 1}} = \frac{[H^+] \text{ at pH 3}}{[H^+] \text{ at pH 1}}$$

$$= \frac{10^{-3}}{10^{-1}} = 0.01$$

15 Consider the following four compounds:

(I) $(CH_3)_3CH$
(II) $CH_3CH_2CH_2OH$
(III) $CH_3CH_2CH_2SH$
(IV) $CH_3CH_2CH_2CH_3$

What is the order of increasing boiling point of the compounds?

A I, IV, III, II

B I, IV, II, III

C II, III, IV, I

D III, II, IV, I

Increasing order of boiling point = increasing order of strength of intermolecular forces, since all four compounds have simple molecular structures.

$(CH_3)_3CH$ and $CH_3CH_2CH_2CH_3$ has induced dipole – induced dipole intermolecular attractions. These are the weakest intermolecular attractions. $(CH_3)_3CH$ has weaker induced dipole – induced dipole intermolecular attractions than $CH_3CH_2CH_2CH_3$ as it is more highly branched and hence more spherical in shape and lesser surface area of contact for intermolecular interactions.

$CH_3CH_2CH_2SH$ has intermolecular permanent dipole – permanent dipole attractions (which is stronger than induced dipole – induced dipole intermolecular attractions) due to the polar S – H bond whose dipole moment is not cancelled.

$CH_3CH_2CH_2OH$ has intermolecular H bonding due to the O – H group.

16 Which one of the following statements would **not** be expected for Group II elements or its compounds?

A Barium sulfate has numerically smaller lattice energy than magnesium sulfate.

B Beryllium forms compound with the least covalent character.

C Barium oxide in water produces an equilibrium with high K_b.

D The heating of nitrates of Group II compounds will result in an increase in entropy.

A Since Lattice energy $\propto \left|\frac{Q^+Q^=}{r^+ + r^-}\right|$, and ionic radius ($r^+$) of Ba^{2+} > Mg^{2+}, barium sulfate will have a numerically smaller lattice energy than magnesium sulfate.

B Beryllium has the smallest ionic radius, hence it is the most polarizing group II cation, therefore compounds of beryllium have the most covalent character.

C Barium oxide dissolve readily in water to form Barium hydroxide, which is a strong alkali, hence it will have a high K_b value.

D Decomposition of Group II nitrates:
$M(NO_3)_2$ (s) → MO (s) + $2NO_2$ (g) + ½ O_2 (g)
Since there is formation of gaseous products, there will be increase in entropy.

17 Which one of the following statements about Group II elements is correct?

A The reactivity with cold water decrease down the Group.

B The charge density of Group II cations increases from Be to Ba.

C The minimum temperature for the thermal decomposition of Group II nitrates increases down the Group.

D The melting point of Group II carbonates decrease down the Group due to the decreasing polarising power of cations.

A Reactivity of Group II metals **increases** down the group

B Cationic radius of group II **increases** down the group, hence charge density **decreases** down the group.

C Since charge density of group II cations decreases down the group, polarizing power of the cations also decreases down the group, hence polarizing effect on nitrate ions decreases and thermal stability **increases**, hence minimum temp required for composition increases down the group.

D Group II carbonates do not melt as they decompose before they can even melt.

18 Which one of the following statement is true of vanadium and its compound?

A The maximum oxidation state of vanadium is found in VO^{2+}.

B V_2O_5 is used as a catalyst in the manufacture of ammonia.

C Zinc reduces $VO_2^+(aq)$ to $V^{2+}(aq)$.

D Vanadium is less dense than calcium.

A From the Data booklet, the vanadium species with the highest oxidation state is VO_3^-.

B Fe is used as a catalyst in the manufacture of ammonia, not V_2O_5.

C From Data booklet, $E^{\theta}_{Zn^{2+}/Zn} = -0.76$ V

$E^{\theta}_{VO^{2+}/V^{3+}} = +0.34$V

$E^{\theta}_{V^{3+}/V^{2+}} = -0.26$V

$E^{\theta}_{cell} = E^{\theta}_{VO^{2+}/V^{3+}} - E^{\theta}_{Zn^{2+}/Zn}$ **=** +0.34 – (–0.76) = +1.10 V

> 0

Hence Zinc can reduce VO^{2+} to V^{3+}

$E^{\theta}_{cell} = E^{\theta}_{V^{3+}/V^{2+}} - E^{\theta}_{Zn^{2+}/Zn}$ **=** –0.26V– **(**–0.76) = +0.5 V

> 0

Hence Zinc can reduce V^{3+} to V^{2+}

D Vanadium, being a transition metal is likely to be more dense than a non-transition metal such as calcium.

19 Which of the following statement describes a phenomenon which can be explained by intermolecular hydrogen bonding?

A Ammonia is very soluble in water.

B CH_3OCH_3 (M_r = 46) has a higher boiling point than $CH_3CH_2CH_3$ (M_r = 44).

C Hydrogen chloride forms an acidic solution when dissolved in water.

D The boiling points of the alkanes increase with increasing relative molecular mass.

A Ammonia has N-H bond while water has O-H bond, hence ammonia molecules form hydrogen bond with water molecules.

B CH_3OCH_3 has permanent dipole – permanent dipole attraction, while $CH_3CH_2CH_3$ has induced dipole – induced dipole attraction.

C Hydrogen chloride dissociates into H^+ and Cl^- when dissolved in water.

D Boiling point of alkanes increases with increasing relative molecular mass due to increasing intermolecular van der waals forces.

20 A compound **Z** has the formula $Cr(H_2O)_6Cl_3$ and a relative formula mass of 266. A 10 cm^3 solution containing 26.6 g dm^{-3} of **Z** requires 20 cm^3 of 0.1 mol dm^{-3} $AgNO_3$ to completely precipitate the chloride ions. Which of the following is the correct structure for **Z**?

A $CrCl_3 \cdot 6H_2O$

B $CrCl_3[H_2O]_3 \cdot 3H_2O$

C $Cr[H_2O]_6^{3+}3Cl^-$

D $CrCl[H_2O]_5^{2+}2Cl^- \cdot H_2O$

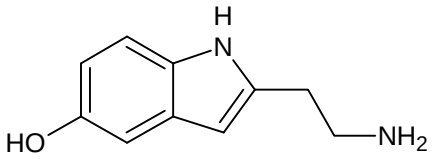
Mass of Z in 10 cm^3 = $26.6 \times \frac{10}{1000} = 0.266$

No. of mol of Z in 10cm^3 = $\frac{0.266}{266} = 0.001$

No. of mol of $AgNO_3$ that reacted with 0.001 mol of Z = $0.1 \times \frac{20}{1000} = 0.002$

Hence 1 mol of Z reacts with 2 mol of $AgNO_3$, meaning 1 mol of Z contains 2 mol of Cl^-, which is precipitated by 2 mol of $AgNO_3$.

21 Serotonin is a monoamine neurotransmitter.



Serotonin

How many sigma (σ) and pi (π) bonds does serotonin have?

Single bond is counted as 1 sigma bond.
Double bonds counted as 1 sigma + 1 pi bond

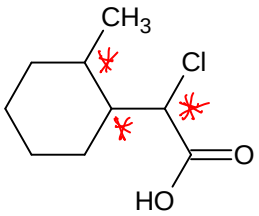
A 26σ and 2π

B 26σ and 4π

C 28σ and 2π

D 28σ and 4π

22 Compound **P** is optically active.



P

How many chiral centre(s) does compound **P** have?

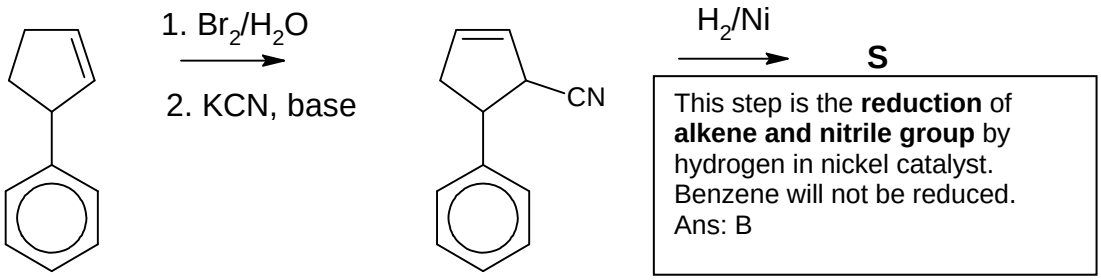
A 1

B 2

C 3

D 4

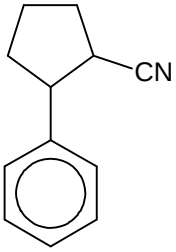
23 A student attempts to synthesise compound **S** from the following synthetic route.



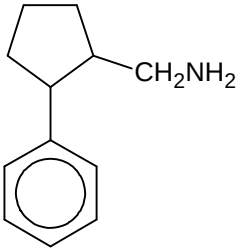
This step is the **reduction** of **alkene and nitrile group** by hydrogen in nickel catalyst. Benzene will not be reduced.
Ans: B

Which of the following could be compound **S** that is formed in this reaction?

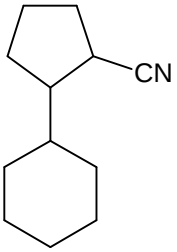
A



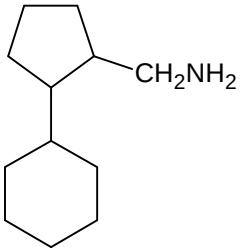
B



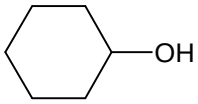
C



D



24 An alcohol **X**, when treated with hot acidified aqueous potassium manganate(VII), gives a final oxidation product which reacts positively to the tri-iodomethane (iodoform) reaction. Which one of the following formula could be **X**?

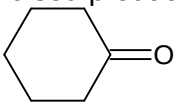
A 

B C_2H_5OH

C $CH_3CH(OH)C_2H_5$

D $C_6H_5CH(OH)C_2H_5$

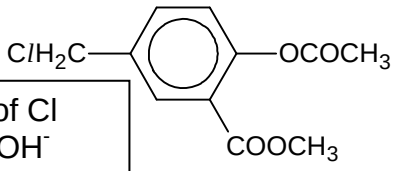
Oxidised product for



A:
B: CH_3COOH
C: $CH_3COC_2H_5$
D: $C_6H_5COC_2H_5$

Only C has CH_3COR structure which gives positive iodoform test.

25 Which one of the following represents the organic ion produced when an excess of hot aqueous sodium hydroxide is added to compound **R**?

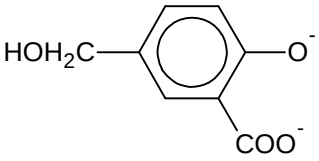


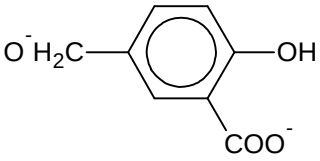
N.S of Cl with OH^-

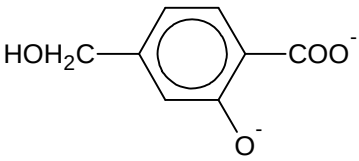
Alkaline hydrolysis of ester to form salt $R\text{-}O^-$

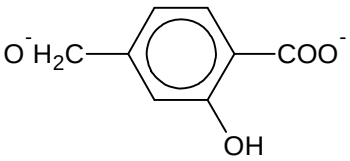
R

Alkaline hydrolysis of ester to form salt $R\text{-}COO^-$

A 

B 

C 

D 

26 Which one of the following, in alcoholic solution, produces a precipitate most rapidly when warmed with aqueous silver nitrate?

A chlorobenzene

B 1-iodobutane

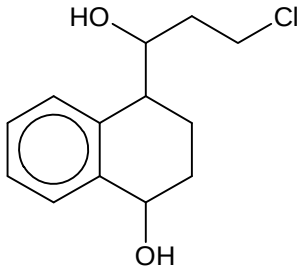
C 1-bromobutane

D 1-chlorobutane

A: C-X bond has partial pi-bond character and will not be broken.

Bond strength of C-I < C-Br < C-Cl
Thus C-I bond cleave most easily, AgI is most rapidly formed.

27 What is the total number of possible stereoisomers that can be formed when the following compound reacts with excess concentrated H_2SO_4?

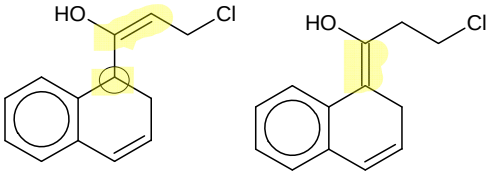


A 2

B 4

C 6

D 8



These are the possible products when compound undergo dehydration with c. H_2SO_4.
There is a pair of optical isomers and 2 pairs of geometric isomers.

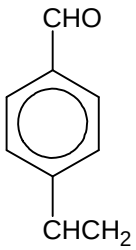
28 Compound **Q** is subjected to the following tests and the results are recorded below.

reagents and conditions	observations
acidified $KMnO_4$ and reflux	Purple solution turns colourless. Effervescence of colourless gas.
Fehling's reagent and warm	No precipitate seen.
Tollen's reagent and warm	Silver mirror is formed.

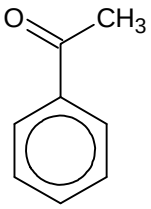
Which of the following could be compound **Q**?

From these information, Q can be oxidized, is an aromatic and NOT aliphatic aldehyde and NOT a ketone.

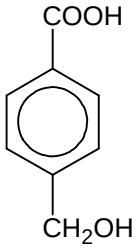
A



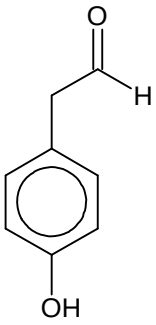
B



C



D



29 The reduction of a nitrile produces a compound of formula $C_3H_7NH_2$. Which of the following would be produced if the same nitrile is heated with hydrochloric acid?

A CH_3CONH_2

B CH_3CH_2OH

C CH_3CH_2COOH

D $(CH_3)_2CHCOOH$

The original compound has 3 C.

$C_2H_5CN \xrightarrow{[H]} C_2H_5CH_2NH_2$

$C_2H_5CN \xrightarrow{H^+} C_2H_5COOH$

30 Separation of benzene from a mixture of benzene and an organic amine could involve

A Treating the mixture with dilute aqueous alkali.

B Treating the mixture with dilute aqueous acid.

C Extracting the amine with cyclohexanol.

D Extracting the benzene with diethyl ether ($CH_3CH_2OCH_2CH_3$).

A: Amine is also basic and mix with alkali.
B: Acid reacts with amine to form a salt which can be easily separated from benzene.
C: Amine mix well with cyclohexanol.
D: Benzene mix well with diethyl ether as both are non-polar.

Section B

For each question, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements which you consider to be correct).

The responses **A** to **D** should be selected on the basis of

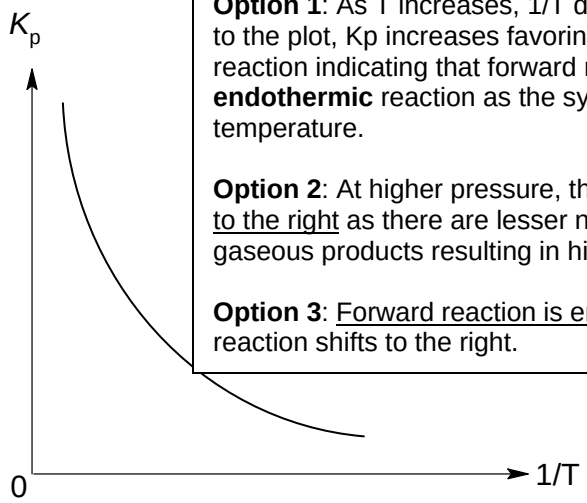
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

31 The equilibrium constant K_p for the reaction

$$\mathbf{P}(g) + 2\mathbf{Q}(g) \rightleftharpoons \mathbf{R}(g)$$

is found to vary with temperature T as shown in the diagram below.



Option 1: As T increases, 1/T decreases. According to the plot, Kp increases favoring the forward reaction indicating that forward reaction is an **endothermic** reaction as the system tries to lower temperature.

Option 2: At higher pressure, the equilibrium shifts to the right as there are lesser number of mole of gaseous products resulting in higher proportion of R.

Option 3: Forward reaction is endothermic. Hence, reaction shifts to the right.

Which of the following conclusion(s) can be drawn from this information?

1 The reaction is exothermic in the forward direction.

2 The equilibrium mixture contains a high proportion of **R** at higher pressures.

3 The equilibrium mixture contains a high proportion of **R** at higher temperatures.

32 Which of the following system(s) contain/s delocalised electrons?

1 cyclohexene

2 graphite

3 sodium

Option 1: Cyclohexene is NOT aromatic and therefore no delocalised electrons.

Option 2: Graphite has delocalised electrons.

Option 3: Sodium has "sea of delocalised electrons".

33 The table below shows the solubility product, in mol dm^{-3} for three metal sulfides. In an acidic solution, $[S^{2-}]_{saturated} = 10^{-18}$ mol dm^{-3}.

Metal ion	Mn^{2+}	Ni^{2+}	Ag^{+}
K_{sp} of sulfide	10^{-16}	10^{-21}	10^{-36}

Which of the metal sulfides would be precipitated from the acidic solution containing 0.010 mol dm^{-3} of the metal ion when the solution is saturated with hydrogen sulfide?

1 Mn^{2+}

2 Ni^{2+}

3 Ag^{+}

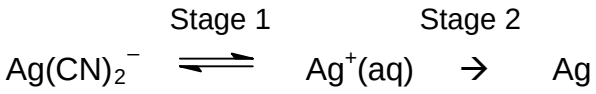
Option 1: Ionic Product of MnS is $1 \times 10^{-18} <$ Ksp

Option 2: Ionic Product of NiS is $1 \times 10^{-18} >$ Ksp

Option 3: Ionic Product of Ag_2S is $1 \times 10^{-22} >$ Ksp

No other combination of statements is used as a correct response.

34 When copper is electroplated with silver, a solution containing both silver nitrate and potassium cyanide, KCN, is used. The process involves the sequence shown below.



Which of the following statement(s) correctly describe this process?

1 The cyanide ions reduce the concentration of aqueous silver ions.

2 Both stages 1 and 2 involve a change of oxidation number.

3 The copper object will be the anode.

Option 1: Cyanide ion being a ligand, will bind to free Ag^+ ions to reduce the concentration of aqueous Ag^+ ions.

Option 2: Ag in Stage 1 are both at +1 oxidation state.

Option 3: Ag which is used to coat Cu, is produced from the reduction of Ag^+. Reduction must occur at the Cathode for this question.

35 For this sequence: hydrogen chloride, hydrogen bromide and hydrogen iodide, there is a decrease in

1 thermal stability

2 bond length

3 ease of oxidation

Option 1: Thermal stability decrease down the Group as the bond strength decrease down the Group.

Option 2: Bond length increase down the Group as the atomic radius of halogen increase down the Group.

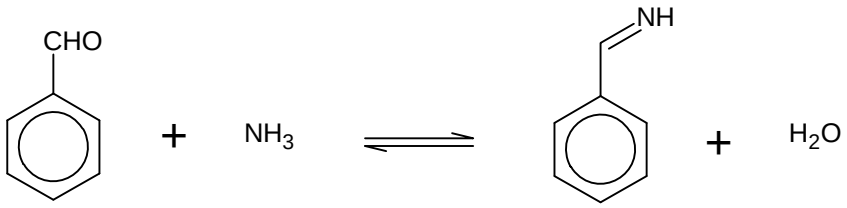
Option 3: Ease of oxidation of halides increases down the Goup as it is easier to lose a valence electron

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

36 Consider the following reaction scheme involving benzaldehyde and ammonia in methanol to form an imine.



Which of the following statement(s) is/are true?

1 Ammonia is the nucleophile in this reaction.

2 The rate of backward reaction is increased by the addition of H_2O.

3 The yield of imine is increased by the addition of NaOH to the reacting mixture of benzaldehyde and ammonia.

Option 1: Ammonia attacks the electrophilic carbon of the aldehyde using the lone pair.

Option 2: Rate of backward reaction is NOT dependent of H_2O which is a product. Shifting of equilibrium to the left results in higher amount of benzaldehyde but not increase rate.

Option 3: OH^- will be a competitive nucleophile to ammonia and not result in a shifting of the equilibrium.

37 When iodoethane is heated to about 100°C in a sealed tube with concentrated ammonia solution, the possible product(s) is/are

1 $C_2H_5NH_2$

2 $(C_2H_5)_2NH$

3 $(C_2H_5)_3N$

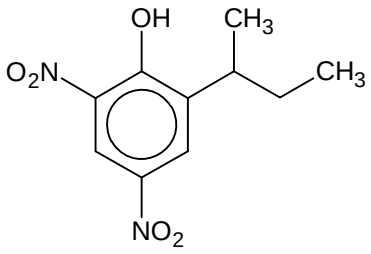
All options are possible as substitution amine will proceed until the amine is fully substituted and forms a quaternary salt.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

38 The compound below is Binapacryl which is often used as a fungicide.



Which of the following statement(s) is/are true about the fungicide?

1 It undergoes a more vigorous reaction with potassium metal than sodium metal.

2 It reacts with ethanoic acid in the presence of concentrated sulfuric acid to give a pleasant smelling liquid.

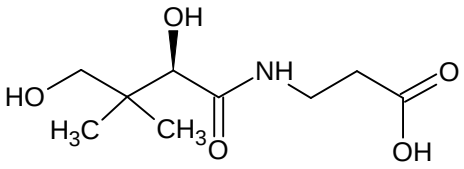
3 It cannot exist as a racemic mixture .

Option 1: Potassium is a more reactive metal than sodium and will react more vigorously with the phenolic group.

Option 2: Esterification to form a phenyl ester will NOT occur under this set of condition.

Option 3: There is a chiral carbon in the compound making it Optically active.

39 V



Which of the following statement(s) correctly describe the chemistry of Vitamin B5?

1 Vitamin B5 reacts with 3 moles of PCl_5.

2 The carboxylic acid group reacts with CH_3NH_2 to form an amide.

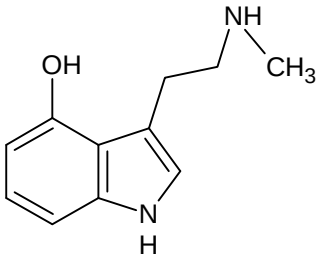
3 Vitamin B5 reacts with 2 moles of HCN.

Option 1: There are 3 –OH groups in the molecule that can react with 3 moles of PCl_5

Option 2: Carboxylic acid will undergo neutralisation with amine instead of nucleophilic substitution.

Option 3: There is only 1 carbonyl group to undergo nucleophilic addition with 1 mole of HCN.

40 *Psilocin* is a psychedelic mushroom alkaloid. It is the active compound that produces hallucinations from ingesting "magic mushrooms" and amplifies sensory experience. Compound **Y** is a derivative of *Psilocin*.



Y

Which of the following statement(s) is/are true about **Y**?

1 It gives white fumes with CH_3COCl.

2 It dissolves in both aqueous acids and alkalis.

3 The nitrogen-containing group in the ring has a lower pK_b than the nitrogen-containing group in the side chain.

Option 1: Ethanoyl chloride is reactive enough to undergo esterification with phenolic OH group to liberate white HCl fumes.

Option 2: Phenolic OH and the side chain amine group can react with base and acid respectively to form a salt.

Option 3: The nitrogen atom in the ring is less basic (higher pK_b) as the lone pair is involved in delocalisation making the 5-membered ring aromatic.

Key:

1	D	11	B
2	B	12	B
3	D	13	A
4	C	14	A
5	A	15	A
6	B	16	B
7	D	17	C
8	D	18	C
9	A	19	A
10	A	20	D

21	B	31	C
22	C	32	C
23	B	33	C
24	C	34	D
25	A	35	D
26	B	36	D
27	C	37	A
28	A	38	D
29	C	39	D
30	B	40	B